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Design of an Open Knowledge Repository and Communication Forum for Biomedical Engineering Education and Research in Indonesia

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Abstract

This paper described the design of an open knowledge repository and communication forum for biomedical engineering (BME) education and research in Indonesia. The knowledge repository aims to develop national capacity in biomedical engineering, which is part of an answer to the challenge provided by the Indonesian healthcare problems. The paper is arranged in five main sections. It starts by outlining the background of development, i.e. the health situation in Indonesia and the potential for biomedical engineering, and continuing on the second section with the current situation of biomedical engineering education and research in Indonesia. The third section outlines the main design issues, while the fourth section discusses the issues surrounding the design and realization, as well as the challenges faced to achieve the project's objective. The paper closes with several conclusions and concluding remarks.

1. Background: The Health Situation in Indonesia

In Indonesia, the field of healthcare is characterized by its sheer size and geographical distribution in more than 13000 islands. Prominent health statistics in Indonesia include the high maternal & child health/mortality and communicable diseases (HIV AIDS, Tuberculosis, dengue, etc).

This condition presents both a huge challenge and opportunity for the field of biomedical engineering, which aims to solve problems in the medical and healthcare fields by utilizing engineering and technological methods. In fact, biomedical engineering should have a higher potential to improve healthcare in developing countries, as there are a larger margin for improvement as compared to developed countries. However, this potential is still largely unfulfilled, as biomedical engineering is still in its infancy stage in Indonesia.

2. Current Situation: BME Education and Research in Indonesia

In the field of education, several biomedical engineering programs or initiatives are being opened in various higher education institutions in Indonesia. However, the efforts are still relatively few, and mostly centered to the main capital island of Java. Some initiatives are full fledged academic departments, while others simply opens up

a more definite research area in their field that are correlated with the interdisciplinary biomedical engineering field.

A common problem includes the lack of faculty configuration with the comprehensive set of competences vital for a strong biomedical engineering competence. This creates several gaps in the pedagogical and curricula aspects of higher education for these initiatives. Institut Teknologi Bandung (ITB), as one of the first universities to develop biomedical engineering departments, has started distributing courses to other universities with positive results, but a more comprehensive and participative approach is still needed. Currently the pilot implementation of a general eLearning network between Indonesian universities is being explored, with biomedical engineering courses being one of the pilot applications. Some possible economic implications of this application is discussed in the 4th section of this paper.

The situation is largely parallel in the research and development field. A significant amount of successful initiatives and research projects, whether local, international or collaborative in nature exists. However these efforts are still highly sporadic and not strongly correlated, and have yet to reach a critical tipping point to bring out its true potential. A more comprehensive and wider access to a network of information regarding existing initiatives, past lessons and experiences, as well as best practices, particularly those geared towards applications in developing countries is needed.

3. Design Issues

3.1. Proposed Solution Concept: A BME Open Knowledge Repository and Communication Forum

We believe that the improvement of higher education and research in this field, specifically by developing better information and communication/collaboration network for education and research opportunities and best practices is vital to answer this challenge. Therefore, an open knowledge repository and communication forum for biomedical engineering is proposed.

The repository is aimed to function as an open source of knowledge and best practices for higher education in BME, as well as a think tank and collaboration space

for researchers, aimed to foster development of interest, linkages and sharing of knowledge between research initiatives and results, linkages between different actors in the biomedical engineering field (students, researchers, government, funding organizations, related institutions, international organizations, and the general public). It is also aimed as a general source of up to date information on existing actors, initiatives, and opportunities in the field.

The idea is a part of a broader research and development roadmap which aims to develop the capacity of biomedical engineering higher education in Indonesia, in particular by developing a learning network utilizing e-learning and other emerging Technologies.

Previous results include the development of Customized Anatomy & Physiology E-Learning Courseware For Engineering Students that has been through a succesful pilot implementation, and currently are in its second year of dual-university application. This software module has received a nomination in Indonesia's ICT award 2007 in the Education section as well as in the APICTA (Asia Pasific ICT Award) 2007. This elearning modules are to be expanded and integrated towards the designed repository as the basis of the first section of the repository content.

3.2. Design Concept: Content

The content of the repository would be divided into three main section

(i) E-learning courseware modules for core and specialized biomedical engineering courses,

(ii) Guidelines and best practices materials from experts regarding biomedical engineering research, cooperation initiatives and developments, specifically geared for Indonesia and developing countries

(iii) A community forum to exchange information and promote collaboration between students, teachers, researchers and all other practitioners or parties with interest to the field (government, funding organizations, general public or related institutions).

3.3. Design Concept: Realization Concept

Currently, the preliminary design framework utilizes the Moodle open source Learning Management System (LMS). The courseware modules, guidelines and main best practices would be organized in an eLearning course format, with a comprehensive set of facilities for open user participation in the form of review, comments, discussion forum and contributions.

The Moodle LMS is chosen due to several advantages:

- Moodle is an open source program with a strong development/user community base.
- It is highly customizable and is equipped with an array of suitable tools.
- It has good flexibility and ease of use for both the development and user interface area, especially suited to the biomedical engineering courses and guidelines sections of the content.

To insure content integrity, user contributions that are in the form of knowledge modules (as opposed to general discussion and comments) would be subject to peer review by a rotating committee comprised by members of academic faculties and other authorities for biomedical engineering in Indonesia.

The other sections would be organized in a more flexible discussion forum manner, with a more open approach for user contribution. This forum would also be moderated by a rotating committee whose main task is to regulate the forum and ensure content integrity. Periodic review and summarizing of accumulated knowledge and information would be done at least on an annual basis. Ideally, this would be done by way of a periodic discussion regarding the matter in an online or face-to-face conference involving a comprehensive representation of the national biomedical engineering actors.

Currently the main design framework design is being fine tuned, while efforts to form the baseline (starting-point) repository are continually ongoing. Current efforts include gathering resources from national experts and practitioners of biomedical engineering and related fields (healthcare, healthcare organization, engineering experts, etc.), gathering available local and international online resources, as well as

gathering and mobilizing members and relevant participants to form a main advisory committee and maintenance personnel for the program.

The main advisory committee are expected to be consisting mainly of an annually rotating core members of university faculties, with representatives of students and practitioners of relevant fields (e.g. industry, health, higher education and public policy) representing the relevant stakeholders of the issues at hand. Several key topics would be the responsibilities of smaller teams ensuring content accuracy and currency. Cooperation with international educational, research and other relevant institutions will be developed during the course of preliminary introduction of the system. The project would firstly be introduced in universities with relevant interest in biomedical engineering. Approaches to relevant stakeholders (practitioner, health institutions, government) will be made concurrently.

4. Discussion

4.1. Realization Concepts

The Moodle LMS realization is particularly suited to a coursework structure realization of the repository. An alternative option being considered is the use of topic map to better create a knowledge structure regarding biomedical engineering in Indonesia or developing countries. This approach presents a potential complementary aspect for the learning process and knowledge structurization/accumulation of the repository.

4.2. Sustainability Factors

The modular courseware structure of the content allows flexible development according to a particular user's or group need. It is expected that custom "tie-in" modules would continue to be developed, not only by the original course author, but also by other instructors and learners according to their course needs. The agglomeration of these modules will in turn become a resource "library" that will enrich the field of teaching in anatomy & physiology, especially for engineers.

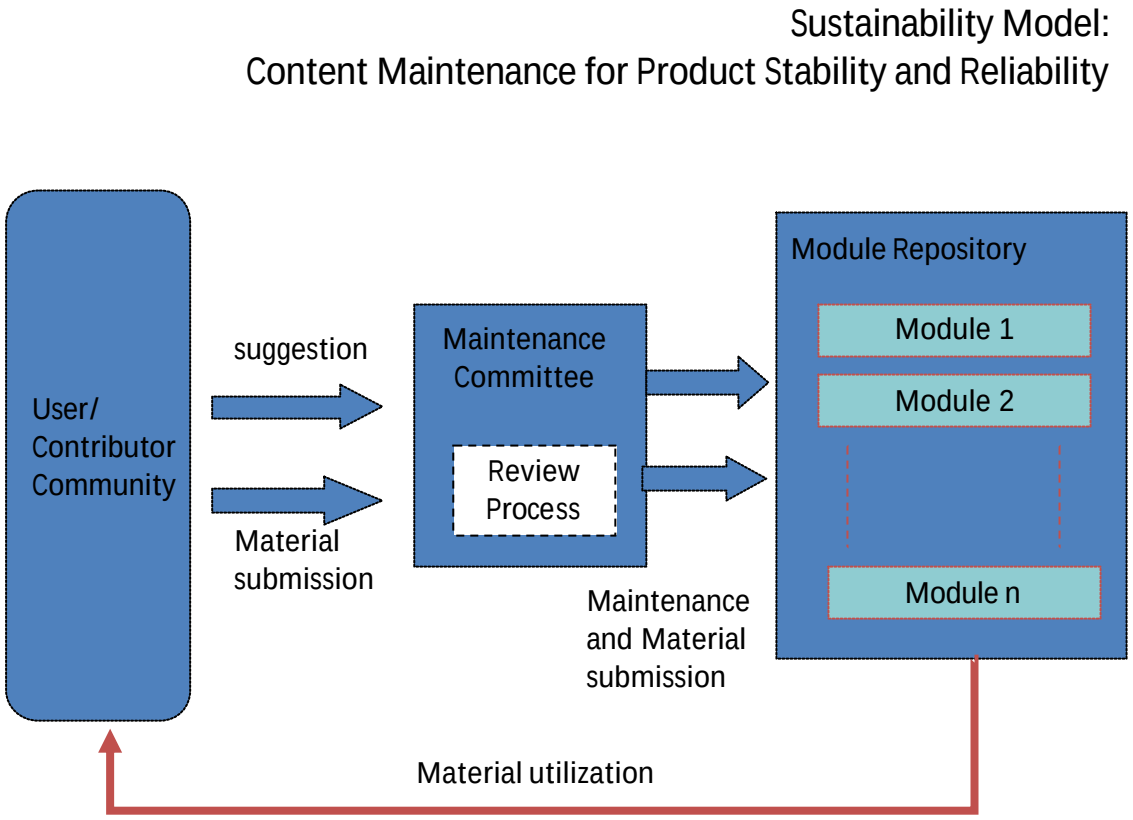

Figure 1. Sustainability and Maintenance Model for the System Content Maintenance

4.3. Potential Economical Aspects for The Distant Learning Coursework Modules

One of the main purpose of distant learning is to compensate for the potential lack of specialized lecturers on a certain specialized field, a case which is quite prevalent in developing countries like Indonesia. The economical ramification of the development of this e-learning courseware will be the capitalization and utilization of expert staff at the 1st higher education biomedical engineering program in Indonesia for pioneering teaching effort in other universities.

If such economical ramification is to be applied to all Indonesian universities which teaches both medical and technical fields, we could be talking about a dozen universities which could benefit from this effort.

One year usage of this courseware could compensate for at least 12 person-months of a secondary degree lecturer, which in turn could be equal to 120-150 million

rupiah per annum. With the benefit time span of 1-3 years – 1 year of introductory usage and 1-2 years to a university to develop its own lecturers – this could easily mean around 3 billion rupiahs.

4.4. Some Potential Challenges in Implementation

The main challenges to be overcome in this project and further developments includes technical and non technical challenges. The technical challenges include improvement of technical infrastructure, realization structure, development of knowledge structures and the development of optimal collaboration methods, while the non technical challenges include ammassment of critical mass of content and user, maintaining the dynamic nature of the repository, acclimatizing users for online collaboration, improvement of modules to suit particular user needs, and how to incite more participation.

5. Concluding Remarks: Further Developments, Challenges and Hopes for the Future

This paper has described the design of an open knowledge repository and communication forum for biomedical engineering (BME) education and research in Indonesia This design model is expected to have a national impact in biomedical engineering higher education in Indonesia.

The main challenge of this design is to gain the critical mass it needs to have a significant effect for improvement, both in content and follower (user) quantity and quality. Also underlying the issue is the requirement to maintain the content integrity and up to date mechanisms it needs. Cooperation between existing initiatives and a good strategy for publication and dissemination is vital. Although the base design for this repository is geared towards biomedical engineering in Indonesia, in practice this model can be extended to applications on any field of education or country/region. Eventually it is hoped to participate in becoming a focal point for local generated BME solutions for developing countries. Naturally, contribution from international and regional sources from all relevant fields would make a very valuable contribution. Potential fields of contribution include the health, engineering, education, policy and other social fields.

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New cultural, educational and inter-personal phenomena are clearly emerging from the use of technologies capable of enhancing social networking (O'REILLY, 2005; OBLINGER & OBLINGER, 2005), but little research has been made addressing the psycho-pedagogical foundations and implications of this new technologies. Departing from an analysis of the Social Web from diverse theoretical perspectives, namely Social Constructivism, Connectivism, Distributed Cognition, Situated Learning, and Collective Intelligence, we intend to address those challenges, in order to explore and clarify the potential and limitations of the so-called "Web 2.0" in Higher Education, from a psychological oriented perspective.

1. Introduction

In our society, knowledge is a major component of any activity, and the driving force of change and innovation (UNESCO, 2005). Colleges and Universities have a key role in promoting high quality and reliable education and the development of knowledge, but are far from being the only (or even the main) source of information and knowledge nowadays, due to the expansion of new forms of communication (most notably the Internet). From the use of Information and Communication Technologies (ICT), a global society arouse, and knowledge is now shared without constrains of geographic proximity.

In places like Europe and the United States, there is a new generation of students entering Higher Education institutions who have grown within an environment where information technology has opened unprecedented opportunities of social interaction and peer-construction of knowledge. Also, the emergence of social software has enabled people to connect and collaborate throughout computer-mediated communication and to easily form online communities. Furthermore, projects like the One Laptop per Child (NEGROPONTE, 2005), allied with the exponential growth of computer and internet capabilities makes any debate about the impact of ICT in Education extensible to countries that have been so far deprived of this kind of technology. Our main goal is to address such challenges in this paper.

2. The University and the *Social Web* Challenge

2.1. Community, Participation and Higher Education

Higher Education Institutions (HEIs) are facing strong pressures to adjust their methods of knowledge creation, sharing and preservation (and even the way the knowledge evaluation process is conducted), due to the technological changes of the past years. Many of the major HEIs are already testing new forms of accomplishing their social mission. We can state, as examples, initiatives like the MIT *Opencourseware*, Berkeley's *Webcast.Berkeley* initiative or the Open University's (UK) *OpenLearn'* project, only to name a few leading schools that are adopting forms of communication that were unforeseen a mere decade ago.

The generalized use of the Internet, and specially the World Wide Web, is only less more than a decade (as of early 2008), and yet the nature of communication on the Web has been deeply transformed recently, with the introduction of tools and services which allow for a much greater participation of people in the generation of online material. There is a new generation of students who are accustomed to these technologies and who use them to share knowledge and information outside the strict context of the traditional classroom. Navigating the Web, we can see people of all ages taking active roles in geographically disperse communities, collaborating and building knowledge through interaction and self-regulatory social dynamics.

Furthermore, the worldwide development of knowledge societies offers a unique chance for less developed countries to catch up with industrialized countries, taking advantage of technologies that allow a widespread dissemination of knowledge (UNESCO, 2005). At the heart of the effort to build knowledge societies is the understanding that knowledge can be a decisive instrument of development, empowerment and capacity-building. The MIT OpenCourseWare (OCW) initiative's motto is precisely "unlocking knowledge, empowering minds", and this program was initiated to provide the dissemination of knowledge and collaboration among scholars around the world. Although only 1% of OCW traffic since 2004 came from users on sub-Saharan Africa, this represents about half a million visits, and projects like OpenAfrica (2006) or African Virtual University (2005) were started to enhance the use of ICT in this region. Most importantly, MIT's initiative was followed by a number

of other institutions making their courses available as open educational resources, available for use to students and educators all over the world.

Tim O'REILLY (2005) coined the term *Web 2.0* to refer to the *revolution in the computing industry caused by the move to the Internet as a platform*. It is difficult to define concisely what this concept means, since it covers such a wide range of applications, including *Blogs*, *Mashups*, *Wikis*, feeds to *social bookmarking*, *social networking* and *media sharing* sites. Although few people use all of these tools, many use one or more. We can say that, in its essence, Web 2.0 is a *participatory* Web. By lowering the barriers to participation, the Web 2.0 concept goes beyond the idea of opening software code to developers: it states that content production of online information must be opened to all users, who must be allowed to re-use and *mash up* data as they want and need (O'REILLY, 2003).

A key feature of Web 2.0 services is what O'REILLY (2003) calls an *Architecture of Participation*, i.e. through normal use of the application or service, that service appears, to the user, to become better. Web 2.0 software is designed so that the user interactions have the *side effect* of improving the service (e.g. Del.icio.us tags, Yahoo Answers user points, BitTorrent sharing protocol).

Most Universities today still use a centre-staged model of teaching, in which discipline experts transmit theoretical knowledge that passive learners receive and consume. In a model of this type, collaboration is discouraged, and students who engage in collaborative learning strategies have to so removed from the official lecture hall, as if they were carrying subversive or illicit methods in their learning (HERRINGTON & HERRINGTON, 2005). Many teachers follow a traditional approach to teaching because they are just reproducing the way they themselves were taught, ignoring recent theory and research on human learning. Traditionally, the University is a place where theory can be learnt devoid of its originating context. In many cases, this potentially leads to *superficial* learning of theoretical materials by the student (e.g. textbooks) who then regurgitates the information on exams (HERRINGTON & HERRINGTON, 2005).

It is imperative to take advantage of the free and open educational resources, opencourseware and open software that is available and to promote a participatory learning culture in which learners build, explore, share and collaborate together online.

The use of Web 2.0 technologies in the context of Higher Education could lead to the implementation of a model of learning centred on the concept of *Community of Practice* (LAVE & WENGER, 1991), in which learners are seen as participants of a framework that has social structure, rather than being passive elements that acquire models of a static world. Peer-pressure to enhance performance and to participate in collective activities is a factor that promotes the building of ethical relationships between people involved in a Community of Practice.

In the wider community, there is a need for a dynamic and adaptable workforce, but employers and governments now realize that in many cases the learning outcomes they need from university graduates are lacking. Nations, employers and governments require graduates who are able to build communities, and to communicate in innovative ways, in the realm of their profession (HERRINGTON & HERRINGTON, 2005).

The growing influence of constructivist ideas in learning (VYGOTSKY, 1978), has prompted many educators to research and implement more *authentic* (real world) learning environments, in which teaching and learning takes place in settings closer to real-life scenarios, and thus adjusting better to the concrete needs of students and Society (e.g. MCLELLAN, 1996; COBB & BOWERS, 1999). Nevertheless, the adoption of new methods of teaching and assessing knowledge must be preceded by a careful analysis of their pedagogical justification, educational advantages and practical implications. There are persistent complains about the use of information and communication technology in educational contexts without a solid psycho-pedagogical foundation (e.g. ATTWELL, 2004; BARONE, 2005; STAGER, 2005). But even seemingly "obvious" assumptions, like taking for granted that students value the use of Web 2.0 tools in the context of their college education, have been disputed by some, based on empirical data. KVAVIK (2005), for example, found that although students value the moderate use of technology in their classes (providing conveniences such as syllabi, class readings, online submission of assignments), they also ranked face-to-face interaction at the top of their list of educational preferences. According to

OBLINGER and OBLINGER (2005), colleges and universities should not assume that more technology is necessarily better. For instance, in a campus where wireless communication has been implemented, its main use may be outside the academic realm. In order to take advantage of this technology to promote collaboration and harness collective intelligence, the whole community of learners and teachers must work together in creating an adequate architecture of participation.

2.2. Collective Intelligence, Collaboration and the University

The idea of *Collective Intelligence*, despite being around for more that a decade (e.g. LEVY, 1997), is now giving rise to new insights on educational processes (DOWNES, 2006), and emergent phenomena like *Wikis* (e.g.*Wikipedia*) are a good demonstration of the power of collaboration through technology.

In the context of Web 2.0, O'REILLY states that there is an implicit *architecture of participation*, a built-in ethic of cooperation, in which the service acts primarily as an intelligent broker, connecting the edges to each other and harnessing the power of the users themselves. (O'REILLY, 2005).

Social-cognitive competences are being more valued each day, and they can also be developed through the use of the Internet (MONEREO, 2005). Social Constructivism emphasises the negotiation and the co-construction of meaning with others (BONK & CUNNINGHAM, 1998). VYGOTSKY (1978) and the followers of social constructivism view learning as a social process: the learner benefits from the support of a teacher or colleague who is at a higher level of development, in order to advance in her learning.

With the availability of Web 2.0 tools, publishing information becomes easy, and several studies (and the empirical experience of many teachers) have demonstrated that when the student knows that his/her work will be available on the Internet, they do it with much greater interest and effort (CRUZ & CARVALHO, 2006; EÇA, 1998). This effect is even more enhanced if there are channels through which the student can receive direct commentary on his/her work (e.g. via a Blog).

Collaborative learning involves the making of meaning in the context of joint activity. This learning is not merely acquired through interaction: it consists *of* the

interactions that occur between participants (STAHL, KOSCHMANN, & SUTHERS, 2006).

We need, therefore, to understand how the cognitive processes are influenced by the social interaction and how learning takes place in the interactions between participants.

Recently, SIEMENS (2004) has been applying ideas similar to those of the sound theoretical framework of Connectionism (RUMELHART & MCCLELLAND, 1986) into the realm of Education, under the term *Connectivism*. Although connectionism as proved to be a very productive theory to explain distributed cognition at the individual level, SIEMENS' *Connectivism* is an emergent perspective on how knowledge can be distributed through networks of people and appliances (and not just distributed in the individual's brain, as in the case of classic Connectionism).

Essentially, a Connectivist view of knowledge postulates that (SIEMENS, 2004):

A. learning and knowledge resides in the diversity of individual perspectives

B. learning is a process of connecting information sources (i.e. connecting nodes in a network)

C. learning may reside in non-human appliances (e.g. a database, but also a community, a network, etc): organizational and personal learning are integrated tasks.

D. the capacity to know more is more critical than what is currently known: learning is a knowledge creation process

E. the ability to see connections between fields, ideas, and concepts is a core skill, since the individual is *participating*, as a node, on a *network that learns*

F. accurate and up-to-date knowledge is the intent of all connectivist learning activities

G. maintaining and enhancing connections is needed to facilitate continual learning

H. since reality is dynamic, the process of decision making must be also subject to the laws of learning and self-actualization.

Web 2.0 fits well into a connectivist model of learning, comprising a panoply of tools that could lead to an Education directed to the needs of a Society that requires

skilled workers, and critical and creative thinkers, even if terms like *Wikis*, *Blogs*, *Podcasts*, *RSS*, *Mashups* might sound like hype and complex jargon to the general public (including many educators). In this respect we cannot restrain ourselves from totally agreeing with SIEMENS (2007) opinion that the tools are not central for an understanding of the potential impact that an idea like Connectivism may have in Higher Education: what is central is the *change* that this tools would allow if they were used in its full transformative potential.

3. The New Public(s) of Higher Education

3.1. The *Net Generation*: A Psychological Profile

According to STRAUSS & HOWE (1997), current traditional-age (18-24) university students belong to a generation they call *Millennials*. This is a group of people that have grown up with networking technologies (from the Internet to Mobile Phones), and have thus gain unprecedented multitasking capabilities, allied to expectations of fast interactions with information channels and an intrinsic desire for connectivity. TAPSCOTT (1997) and OBLINGER and OBLINGER (2005) call this students the "Net Generation", thus emphasising the importance of information and communication technologies when searching for a generational taxonomy that fits well with these students. Back in 1998, when the Internet was less developed and today's university students were children, the term employed to describe them was *Nintendo Generation*, a classification that allow us to understand how these students developed their multitasking and rapid information processing abilities, although being insufficient to explain their tendency towards networking and social participation (STRAUSS & HOWE, 1997).

Even if people of all ages live surrounded by technology (in the western world, lets not forget, for this is not irrelevant, of course), authors like PRENSKY (2002), distinguish between *Digital Natives*, i.e. people for which current technology is as familiar for them as their mother tongue, and *Digital Immigrants*, older people who have not been exposed to the new tools since they were very young, and therefore use present-day IT in a less instinctive way. A *Digital Immigrant* compares to a *Digital Native* in the same way a native English speaker compares to a person who starts

using English in his/her adolescence or adulthood (PRENSKY, 2002). Of course, we see many learned adults becoming more proficient in a foreign language than some of its native ill-educated speakers, but there is a tendency for natives to learn the competency effortlessly, and in a much more intuitive way.

People who are now in their late teens or early twenties have never known a world without computers with large, trustable mass-storage, cyberspace, and multimedia capabilities. For them, Iraq was always a Country at war with the West, and Europe has always been a place without borders. There are many differences between individuals within this generation (dictated by socio-economic class, gender, geography), but there is also much communality. It is the part of their personal history they share with each other, and the fact that they all passed by global historical events at about the same age, that allow psychologists to talk about *cohort effects* (SANTROCK, 1998). STRAUSS and HOWE (1997) even refer to the concept *Personality of a Generation*. Although the use of the term "personality" is debatable when applied to a group of people, we can see it as an extension of the concept of an individual's personality, i.e. the characteristics possessed by a person that uniquely influences his or her cognitions, motivations, and behaviors in various situations (RYCKMAN, 2004).

Students belonging to the *Net Generation* (also labeled *Millennials*, or more controversially *Generation Y*), have been exposed to digital technology in virtually all facets of their lives. This had, and still has, a profound impact in their individual personality, in the way they relate with other people, and in the way they see the world. As a group, they also show some distinctive psychological characteristics. In particularly, young people belonging to this generation tend to exhibit (TAPSCOTT, 1997):

1. Well developed multitasking capabilities
2. Active preference toward knowledge construction, rather than following instructional pedagogical designs
3. Little tolerance for delays: technology taught them to expect immediacy
4. Easiness in interactive settings, were they are not just viewers, but also actors.

3.2. Non-traditional Students and Lifelong Learners

Education is mentioned in the Universal Declaration of Human Rights of 1948 has a fundamental Human Right (UNESCO, 2005). The ubiquity of Web 2.0 tools in schools, at work, and at home may have a profound impact in the realization of the lifelong learning agenda, allowing the establishment of *Learning Networks*: networks of people and organizations that create, share, support and study learning resources ('units of learning') in specific knowledge domains. (KOPLER & SLOEP, 2003).

Life-long learning emphasizes that it is never too late to learn. In an increasingly demanding world, where each person may need to have more than one profession in the course his/her working career, lifelong learning becomes indispensable.

According to ASPIN & CHAPMAN (2000), the goals of lifelong learning are: 1) to enhance economic progress and development; 2) to contribute to personal development and fulfilment; 3) to promote social inclusiveness and democratic participation.

Web 2.0 tools can contribute to a type of lifelong learning well suited to the characteristics of older students and the needs of society as well: these technologies allow students to participate in activities they enjoy, and learning may then come as a by-product of participation. According to MASON (2006), this is a “lesson” about lifelong learning that educators need to learn.

4. Learning in a Connected World

4.1. Learning, Society and Psychological Development

Psychologists such as PIAGET (1960/1995) and VYGOTSKY (1978) emphasized the social nature of learning, particularly in situations in which learners are faced with challenges they cannot solve alone, without the resources of a group. *Discussion*, a process by which members of a group present their ideas to others and receive feedback, provides the cognitive scaffolding necessary for higher-level thinking (VYGOTSKY, 1978). This type of activity is inherent to Web 2.0, allowing us to expect major potential impacts in Higher Education if these technologies are integrated in teaching practices at this level. A good example of a concrete, real world application of

the somewhat abstract principles mentioned above can be seen in the community-driven website *Yahoo Answers*, where users can ask a question, and then receive answers from others. Everybody receives bonus for participating (both asking questions and answering them), but the person whose answer is considered the best receives more points: this ensures wide participation, since there's a tendency for new questions (and answers) to appear, and also tends to promote quality, since the best answer is given extra points.

The dynamics and exchanges that take place in virtual communities like Yahoo Answers have clear resemblances with those that HUTCHINS (1995) considered to be typical of a *Learning Society*. The author popularized this term to denote the new kind of society in which the old limits on *where* and *when* knowledge could be transmitted no longer apply. In this society, the "human actor" must be put at the heart of the process of knowledge acquisition and communication.

Continuing to analyse Yahoo Answers as a concrete paradigmatic example of a typical Web 2.0 service, another important aspect deserves to be emphasized: the typical person who asks a question is actually facing a personal, educational or professional difficulty related to his/her life. Therefore, in Yahoo Answers we can see a clear realization of the concept of *Community of Practice* referred earlier (LAVE & WENGER, 1991).

This example serves also to reinforce that what is at stake, in the case of the concept of Community of Practice, is more than just *learning* (and certainly much more than a didactic conception of learning as a measure of teaching effectiveness). Rather, the main focus is the relationship between learning *and* the whole social and personal spheres (RODRÍGUEZ ILLERA, 2007). Community appears as the centre of social life, and the main reference framework for each individual. Learning is not a goal in itself, but rather one feature more on the full experience of participating on a Community of Practice.

4.2. Social Web Technologies and Learning

Simply adding technology to previously existing activities in the classroom does not produce positive results in student learning, if the habitual teaching practices remain

the same (JONASSEN, 1996). Many times, teachers are not at ease with the IT tools they use in their practice, and the integration of Web 2.0 tools in teaching and learning requires a modification on teaching strategies and methodologies. Education Media, *per se*, will never be determinant of student performance (CLARK, 1994). The benefits of using a given technology in teaching only arises when a "wholehearted" approach is used, in which teachers fully take the technology into the centre of the educative process, and explore the full potential of the new tools in allowing challenging and creative activities. This also agrees with the Vygotskian perspective on teaching and learning: VYGOTSKY (1978) postulated that true education must come from life, and that the teacher must exemplify the relevance of the learning material by using it herself as a productive member of Society. Since the concept of Web 2.0 comprehends tools that allow individuals to participate in socially mediated activities, the relevance of Vygotsky's Social Constructivist ideas cannot be overstated.

On the light of Social Constructivism (VYGOTSKY, 1978), it can be predicted that, as the use of Web 2.0 enhances social interactions, it will have a profound impact on the course of development of students: These are IT tools that are expected to exert a radical change in the way in which people perceive both the world and themselves. For example, the development of cognitive structures depends largely on the ability of *cognitive decentration*, which can be exemplified by being able to cooperate with others, and to argue and counter-argue in Blogs, or in the making of a Wiki.

The participatory, dynamic and collaborative nature of Web 2.0 is where the promise of the new tools resides. The move toward read/write connective technologies is changing the way in which goods and services are being produced (TAPSCOTT & WILLIAMS, 2006). In Education this change can take the form of a style of interaction in which students can alternate with their teachers in the role of being active and leading the processes of learning and knowledge construction (ROBERTS, 2005).

5. Final Remarks and Recommendations

Web 2.0 services allow the harnessing of the power of groups. In order to take advantage of the *network effects* of these tools in Higher Education, open, participatory architectures for ICT systems must be in use. Students must be allowed and encouraged to produce their own content. Social networking technologies have the potential to enhance the dynamics of communication between life, work and school, thus creating meaningful educational experiences, adapted to both students' expectations and Information Society's requirements, taking into account that we are now in a true global society, and thus Higher Education Institutions must provide the knowledge to develop a global citizenship. This also leads to an emotion-related type of learning.

What remains the core challenge of the adoption of Web 2.0 in Higher Education is the balance that must be made between the necessary conservative part of Education, which is necessary to preserve past human effort and talent, as also traditional skills and knowledge legacy, and the possibilities that technology introduces in terms of students' self expression and co-construction of knowledge.

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